

रंग रोगन और वार्निश के लिए ब्रश —  
अंडाकार फेरूल कसे हुए, तथा  
गोलाकार, फेरूल कसे हुए  
( छठा पुनरीक्षण )

Brushes, Paints and Varnishes —  
Oval, Ferrule Bound; And  
Round, Ferrule Bound  
( Sixth Revision )

ICS 97.170

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## FOREWORD

This Indian Standard (Sixth Revision) was adopted by the Bureau of Indian Standards after the draft finalized by Brushware, Polishes, Lac and Lac Products Sectional Committee has been approved by the Chemical Division Council.

Oval, ferrule bound brush is meant for excellent painting jobs, such as varnishing or superior finishing of painting work, while round, ferrule bound brush is recommended for rough painting work like preparing of ground or for applying of undercoat of filler on surfaces under painting.

This standard was first published in 1954 and subsequently revised in 1966, 1975, 1985, 1997 and 2012 respectively. In this revision, test method for identification of rubber sample has been suitably included along with burn test, tapering test and tear test. Also, all amendments have been incorporated in the standard. Further, packing and marking clause has been updated.

The composition of the committee responsible for formulation of this standard is listed in Annex H.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value shall be same as that of the specified value in this standard.

*Indian Standard***BRUSHES, PAINTS AND VARNISHES — OVAL, FERRULE  
BOUND; AND ROUND, FERRULE BOUND***( Sixth Revision )***1 SCOPE**

This standard prescribes the requirements and the methods of sampling and test for brushes, paint and varnish (i) oval, ferrule bound; and (ii) round, ferrule bound, made from bristles and set in a suitable cement.

**2 REFERENCES**

The following Indian Standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

<i>IS No.</i>	<i>Title</i>
IS 321 : 1964	Specification for absolute alcohol ( <i>revised</i> )
IS 380 : 1978	French chalk technical ( <i>second revision</i> )
IS 534 : 2021	Benzene — Specification ( <i>fifth revision</i> )
IS 539 : 1974	Specification for naphthalene ( <i>second revision</i> )
IS 707 : 2011	Timber technology and utilization of wood, bamboo and cane — Glossary of terms ( <i>third revision</i> )
IS 1844 : 1993	Bristles ( <i>second revision</i> )
IS 3400 : 2021	Methods of test for vulcanized rubber: Part 1 Tensile stress-strain properties ( <i>fourth revision</i> )
IS 5060 : 1969	Glossary of terms used in brushware industry

**3 TERMINOLOGY**

**3.1** For the purpose of this standard, the definitions given in IS 707, IS 5060 and the following shall apply:

**3.1.1 Approved Tender Sample** — The sample accepted by the indenter or inspection authority as basis for supply.

NOTE — When a sample is tested and approved by the purchaser or an inspection authority, the results of such tests

as will permit the supplier to meet the limits imposed by the specification for deliveries, shall be made available to the supplier. However, all tests need to be carried out on the tender sample.

**4 TYPES**

Brushes shall be of two types, namely:

- a) Oval, ferrule bound; and
- b) Round, ferrule bound.

**5 SIZES**

Oval, ferrule bound brushes shall be of five sizes with denominations 1/0, 2/0, 3/0, 4/0 and 6/0 and round, ferrule bound brushes shall be of 2/0, 3/0 and 4/0.

**6 REQUIREMENTS****6.1 Materials**

The brush shall be manufactured from the following materials:

**6.1.1 Filling Materials**

**6.1.1.1** Selected, properly straightened bristles of natural colour (conforming to IS 1844) and of description given below shall be used:

- a) For brush, oval ferrule bound — soft or semi-stiff/stiff black bristle; and
- b) For brush, round ferrule bound — semistiff/stiff grey bristles.

**6.1.1.2** As regards colour, luster and stiffness, the bristles shall match those used in the approved tender sample. The solid dressing of bristles used shall be as per the approved tender sample, if so agreed to by the indenter; otherwise it shall comply with the provisions given in IS 1844.

NOTE — IS 1844 does not give the qualitative characteristics of bristles. It only defines the solidity of bristles (tops).

**6.1.1.3 Burn Test**

A few filaments shall be chosen at random. Each single filament of the material when burnt at the flag-end shall burn with glowing globular mass at the ignited end. Vegetable fibres burn off without this and the burning progresses rapidly towards the other end. In case of synthetic filaments, a polip will be formed and the droplets will fall down. Further, in case of mixtures of nylon with natural bristles, the bristles will separate individually after burning

whereas in case of mixtures, the same will stick together.

#### **6.1.1.4 Tapering Test**

A few filaments shall be chosen at random. Each single filament of the material shall be held between the thumb and forefinger midway between the flag-end and root-end and rolled with a view to bringing the root-end within the grip. This action in the case of bristles will be in the direction of the taper thus always getting the flat-end within the grip.

**6.1.1.5** In addition to the tests given in **6.1.1.3** and **6.1.1.4**, bristles also have a characteristic tearing pattern described below. However, it may be noted that this test is not considered as confirmatory. Therefore, this test shall be carried out in conjunction with tests prescribed in **6.1.1.3** and **6.1.1.4**.

#### **6.1.1.6 Tear test**

When two tips at the flag-end of a bristle are separately held and torn apart they shall tear, without breaking, right up to the root-end. In the case of hair or vegetable fibres because of their internal morphology this complete tearing apart is not possible. In addition to this, burn test must be conducted to ensure that the material used is natural bristles (as in case of nylon/PET the same will pass the tear test).

#### **6.1.2 Timber**

**6.1.2.1** Any of the timber species listed in Annex A shall be used in the manufacture of handles.

**6.1.2.2** The timber shall be reasonably straight-grained and well-seasoned to a moisture content not exceeding 15 percent, when tested by either electronic moisture meter or by oven drying method as specified in Annex B. However, in case of dispute oven drying method shall be referred.

**6.1.2.3** The timber shall be free from brashness, any kind of biological or non-biological deterioration, insect attack, centre-heart (pith), knots (except live pin knots), cracks, warp and any other defects which may reduce the life of the brush or affect its utility. The handle must be clear lacquered.

#### **6.1.3 Ferrule**

The ferrule shall be of mild steel sheet of thickness  $0.8 \text{ mm} \pm 0.2 \text{ mm}$  and shall also be electroplated.

#### **6.1.4 Plug**

A wooden wedge of suitable size, shape and design shall be used to get required tightness of bristle bunch for cementing, as well as to impart greater flexibility to the brush.

#### **6.1.5 Nails**

##### **6.1.5.1 For oval, ferrule bound brush**

For securing the bridle strip and the ferrule to the handle, four round headed steel nails of 1.40 mm dia and 12.5 mm length shall be used.

##### **6.1.5.2 For round, ferrule bound brush**

For securing the ferrule to the handle, four round headed steel nails of 1.40 mm dia and 12.5 mm length shall be used.

#### **6.1.6 Cement/Setting of bristles**

**6.1.6.1** Bristles shall be introduced from the bottom of the ferrule; the wedge shall be placed in the proper position and the entire mass shall be firmly set in the ferrule with any suitable cement.

**6.1.6.2** In case of rubber set brushes, the rubber compound shall be vulcanized. The test method for identification of rubber sample is given at Annex F.

**6.1.6.3** In no case the setting (the cementing materials or the wedge) shall appear out of the ferrule.

**6.1.6.4** The test to check whether the cement has flown on the bristle portion can be done by thumb test as well as an all pin test. The area immediately outside the ferrule and hair portion will be hard like a rock in case cement has flown out which can be felt with the thumb press. The alternative test for the same can be done with an all pin that is, the all pin should go right through the bristle part ensuring cement is not out.

**6.1.6.5** For fixing the rubber setting and bristles for a longer period, 2 to 4 steel nails may be used. For size No. 1/0, 2/0 and 3/0 nails of size 0.9 mm to 1.2 mm dia  $\times$  20 mm long and for 4/0 and 6/0 nails of sizes 0.9 mm to 1.2 mm dia  $\times$  25 mm long shall be used.

#### **6.2 Dimensions and Tolerances**

**6.2.1** Oval, ferrule bound brushes shall conform to the dimensions given in Table 1.

**6.2.2** Round, ferrule bound brushes shall conform to the dimensions given in Table 2.

**6.2.3** The tolerance on the linear dimensions shall be as specified in Table 3.

**6.2.4** The solid dressing of the bristles used shall be according to the approved tender sample, if so agreed by the indenter; otherwise it shall comply with the provisions given in Table 1 of IS 1844.

**Table 1 Requirements of Brushes, Paint and Varnish, Oval Ferrule Bound**  
(Clause 6.2.1)

SI No.	Size No. (Denomination)	Bristle		Length of Handle		Dia of Ferrule		Bridle Strip		Mass of Bristles per Finished Brush
		Protrusion A <i>Min</i> mm	Overall length B <i>Min</i> mm	Outside the ferrule C mm	Inside the ferrule D mm	Major axis E mm	Major axis E mm	Height G mm	Diameter H mm	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	1/0	70	83	153	13	40	35	40	40	40
ii)	2/0	76	89	153	13	45	40	45	45	50
iii)	3/0	82	95	153	13	50	45	50	50	70
iv)	4/0	89	102	153	13	55	50	55	55	90
v)	6/0	95	108	153	13	60	55	60	60	110

**Table 2 Requirements of Brush, Paint and Varnish, Round Ferrule Bound**  
(Clauses 6.2.2)

SI No.	Size No. (Denomination)	Bristle		Length of Handle		Dia of Ferrule		Mass of Bristles per Finished Brush
		Protrusion A <i>Min</i> mm	Overall length B <i>Min</i> mm	Outside the ferrule C mm	Inside the ferrule D mm	Upper side <sup>1)</sup> E mm	Lower side <sup>1)</sup> F mm	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	2/0	95	108	177	13	45	40	70
ii)	3/0	101	114	177	13	50	45	105
iii)	4/0	108	121	177	13	55	50	120

<sup>1)</sup> These dimensions are internal.

**Table 3 Tolerances on the Linear Dimensions**  
(Clause 6.2.3)

SI No.	Nominal Dimension	Tolerance
	mm	mm
(1)	(2)	(3)
i)	Up to 15	± 1.0
ii)	Over 15 but below 40	± 2.0
iii)	40 and above	± 3.0

NOTE — This tolerance shall not apply to bristles for which minimum lengths have been prescribed in Tables 1 and Table 2.

### 6.3 Manufacture/Purchaser

**6.3.1** Oval, ferrule bound brush shall generally conform to the shape and design shown in Fig. 1.

**6.3.1.1** Details of ferrule and bridle strip of oval, ferrule bound brush shall be as shown in Fig. 2 and Fig. 3 respectively.

**6.3.1.2** In oval, ferrule bound brushes, the bridle strip and the side strip shall be placed in position, and the ferrule and the side strip shall be secured to the handle by means of four nails.

**6.3.2** Round, ferrule bound brush shall correspond to the shape and design shown in Fig. 4.

**6.3.2.1** In round, ferrule bound brush, the ferrule shall be secured to the handle by means of four nails.

**6.3.3** The bristles with wedge shall be properly set and firmly cemented into the ferrule. There shall be no loose bristles and the cement shall not flow out of the ferrule.

#### **6.3.3.1** *Bevelling of working edge*

The working edge of the brush shall be beveled as shown in Fig. 1 for oval, ferrule bound brushes and Fig. 4 for round, ferrule bound brushes.

#### **6.3.3.2** *Test to check whether the cement has flown on the bristle portion*

The area immediately outside the ferrule and hair portion will be hard like a rock in case cement has flown out which can be felt with the thumb press. The alternative test for the same can be done with an all pin that is, the all pin should go right through the bristle part ensuring cement is not out.

### 6.4 Pull Test

The following two methods shall be utilized for pull test when tested as prescribed in Annex C:

- a) Method A — The force required for pulling out an individual tuft shall not be less than 5 kg for 1 min when tested according to the method given in Annex C; and
- b) Method B — when a small bunch of bristles is subjected to a straight pull using of thumb and finger grip, these shall not come out.

Method B shall be for routine testing, and Method A shall be referee method in case of any dispute.

### 6.5 Benzene-Alcohol Test (for ensuring bristles hold to the ferrules)

Immerse the bristles portion (cement part of the brush) for 48 h in a mixture of benzene (*see* IS 534) and denatured spirit (*see* IS 321) (1 : 1 by volume) maintained at temperature  $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . The cement part of the brush must be totally immersed in the benzene alcohol mixture. On completion of this test, the brushes shall show no sign of loosening when used as a brush without paint on a plane surface.

### 6.6 Oven Test (for Ensuring Bristles Hold to the Ferrules)

#### **6.6.1** *For Non-Rubber Set Brushes*

The brush, without handle, when suspended in an oven with the protruding bristle end upwards and subjected to a temperature of  $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 4 h, shall show no appreciable creeping of the cement. Further, after cooling in air for 30 min, the bulk of bristles shall not become loose inside the ferrule and the cement shall satisfy the pull test prescribed under **6.4**.

### 6.6.2 For Rubber Set Brushes

The brush, without handle, when suspended in an oven with the protruding bristle end upwards and subjected to a temperature of  $132^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 2 h, shall show no appreciable creeping of the cement. Further, after cooling in air for 30 min, the bristles shall not become loose inside the ferrule and the cement shall satisfy the pull test prescribed in 6.4.

### 6.6.3 Test method for identification of rubber sample

The test method for identification of rubber sample is given at Annex F.

## 6.7 Detection of Dyed Bristles

The following two methods shall be utilized for detection of dyed bristles when tested as prescribed in Annex B of IS 1844:

- a) Method A — by microscopic examination; and
- b) Method B — by sand paper test.

**6.7.1** Method A shall be the referee method in case of any dispute and Method B shall be used for routine testing.

## 6.8 Curving of Bristles

The processing of bristles when tested by method given in Annex D shall be considered satisfactory if not less than 85 percent of the bristles by mass are as prescribed in **D-3.2** (a) and **D-3.2** (b) out of these 60 percent shall belong to category **D-3.2** (a).

## 6.9 Wear and Tear of the Bristles

The test is required to determine the wear and tear of the bristles during practical use of the brush in

the shops. The length of the bristles both before and after the practical use of the brush shall be measured. The brush shall be kept horizontally on a table. A steel strip about 50 mm wide shall be held vertically over one of its large edges at the bristles end of the brush in such a way that the bristles are just touching the strip. The distance between the lower end of the ferrule and the edge of the strip shall be measured to give the length of the bristles. The length of the bristles shall also be measured at the end of the practical use in the manner described above. Wear and tear of the bristle is the difference of length in the bristle of the above two readings that is, before and after use for 60 h shall not exceed 5 mm.

## 6.10 Mass of Bristles per Finished Brush

The mass of bristles, as determined by the method prescribed in Annex E, shall be as specified in Tables 1 and Table 2. A tolerance of  $\pm 5$  percent shall be allowed on the mass of filling material provided the average mass of the filling material per brush, in any lot, is not below that specified. The average mass of filling material per brush, in a lot, shall be assessed by taking the average mass of filling material of three brushes in lots not exceeding 300 brushes and six brushes in lots exceeding 300 brushes.

## 6.11 Workmanship and Finish

**6.11.1** The handle shall be finished smooth all over and shall be properly varnished or lacquered.

**6.11.2** The ferrule shall be free from sharp edges.

**6.11.3** In general workmanship and finish, the brushes shall match the approved tender sample.

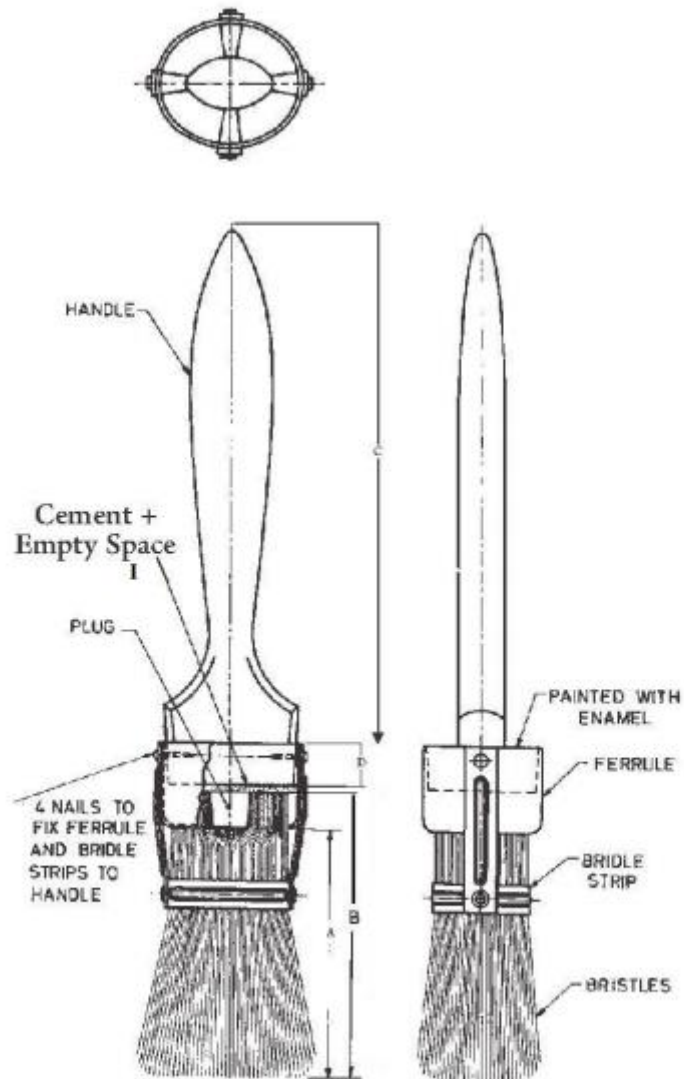
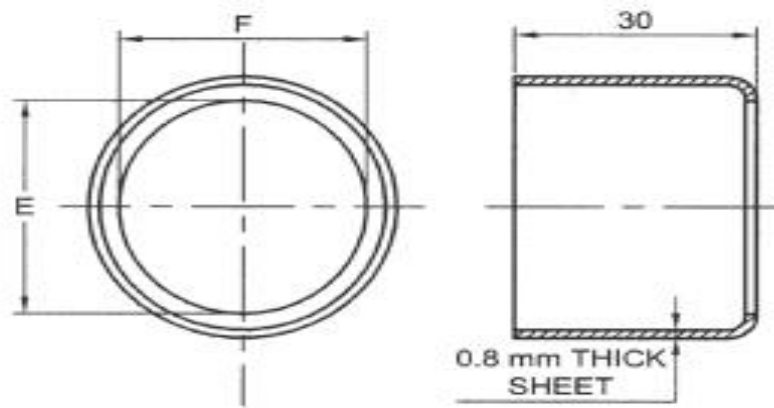


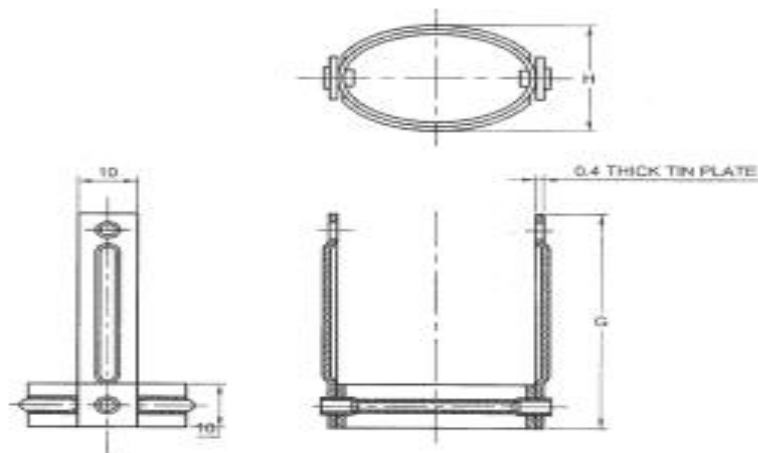
FIG. 1 SHAPE AND DESIGN OF BRUSHES, PAINT AND VARNISH, OVAL, FERRULE BOUND





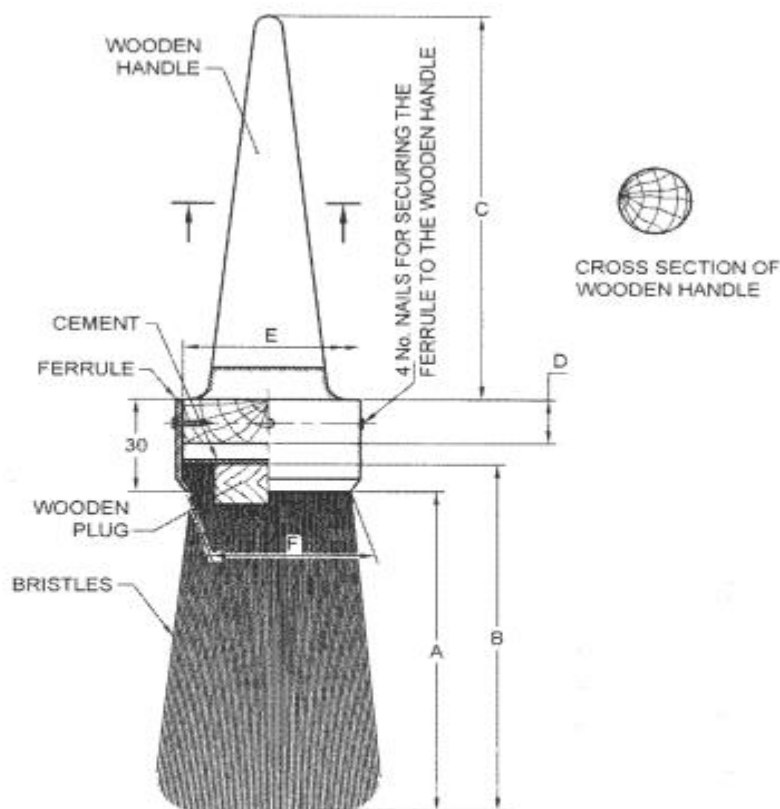
All dimensions in millimetres.

**FIG. 2 DETAILS OF FERRULE OF BRUSHES, PAINT AND VARNISH, OVAL, FERRULE BOUND**



All dimensions in millimetres.

**FIG. 3 DETAILS OF BRIDGE STRIP OF BRUSHES, PAINT**



All dimensions in millimetres.

FIG. 4 SHAPE AND DESIGN OF BRUSHES, PAINT AND VARNISH, ROUND, FERRULE BOUND

## 7 PACKING AND MARKING

### 7.1 Packing

The brushes shall be packed as agreed to between the purchaser and the supplier.

### 7.2 Marking

Each brush shall be legibly and indelibly marked with the following information:

- Indication of source of manufacture;
- The size and type of brush; and
- Month and year of manufacture.

#### 7.2.1 BIS Certification Marking

The product may also be marked with the Standard Mark.

**7.2.1.1** The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed there under, and the products may be marked with the Standard Mark.

## 8 PRESERVATION

The filling material of the brushes shall be liberally dusted before packing with a mixture of 5 percent by mass of BHC dusting powders (*see IS 561*) and 95 percent by mass of French chalk, technical (*see IS 380*). Alternatively, naphthalene ball (*see IS 539*) be used in the packing box for the brushes.

## 9 SAMPLING AND CRITERIA FOR CONFORMITY

### 9.1 Samples

The supplier shall submit four identical tender samples of brushes of each size for approval.

**9.1.1** The indenter or inspection authority shall retain one of the four approved tender samples against each item till the completion of the order.

### 9.2 Sampling

The method of drawing representative samples of the brushes and the criteria for conformity shall be as prescribed in Annex G.

**ANNEX A**  
(Clause 6.1.2.1)

**SPECIES OF TIMBER FOR MANUFACTURE OF HANDLES**

**A-1** The list of species of timber approved for the manufacture of handles for brushes, is given below:

<i>Trade Name</i>		<i>Botanical Origin</i>
Roman	Devanagari	
Aini	ऐनी	<i>Artocarpus hirsutas</i> Lamk., fam. Moraceae
Banati	बनाती	<i>Lophopetalum wightianum</i> Arn., fam. Celastraceae
Bijasal	बीजसाल	<i>Pterocarpus marsupium</i> Roxb., fam. Leguminosae
Champak	चम्पक	<i>Michelia champaca</i> Linn., fam. Magnoliaceae
Chickrassi	चिकरासी	<i>Chukrasia tabularis</i> A. Juss., fam. Meliaceae
Dhaman	धामन	<i>Grewia tilifolia</i> Vahl, fam. Tiliaceae
Gamari (gumhar)	गमारी(गुम्हार)	<i>Gmelina arborea</i> Roxb., L., fam. Verbenaceae
Haldu	हल्दु	<i>Adina cordifolia</i> Hook f., fam. Rubiaceae
Kaim	कैम	<i>Mitragyna parvifolia</i> (Roxb.) Korth. syn. <i>Stepthagyne parvifolia</i> Korth., fam. Rubiaceae)
Kanju	कांजू	<i>Holoptelea integrifolia</i> Planch., fam. Ulmaceae
Kathal	कटहल	<i>Artocarpus heterophyllus</i> Lam. Syn <i>A. Integrifolia</i> Auct., fam. Moraceae
Kuthan	कूथन	<i>Hymenodictyon excelsum</i> Wall., fam. Rubiaceae
Lambapatti	लांबापत्ती	<i>Planchonella longipetiolatum</i> H. J. Lam., syn. <i>Sideroxylon longipetiolatum</i> King et Prain, fam. Sapotaceae
Aam (mango)	आम	<i>Mangifera indica</i> Linn. Fam. Anacardiaceae
Nim-chameli	नीम-चमेली	<i>Millingtonia hortensis</i> Linn. F. fam. Bignoniaceae
Kodapalai (piney)	कोडपलाई(पिने)	<i>Kingiodendron pinnatum</i> Harms, Syn. <i>Hardwickia pinnata</i> Roxb., fam. Leguminosae
Toon	तून	<i>Toona ciliata</i> Roem., syn. <i>Cedrela toona</i> Roxb., fam. Meliaceae

**ANNEX B**  
(Clause 6.1.2.2)

**DETERMINATION OF MOISTURE CONTENT FOR TIMBER USED IN HANDLES FOR BRUSHES**

**B-1 TEST SPECIMEN**

**B-1.1** The entire block used in manufacture of handles may form the test specimen for determination of moisture content or a coupon cut from the test specimen may, as well, be used for moisture content determination. When for any reason additional determination of moisture content is required, separate samples shall be prepared from the sample material as is used in preparing the test specimens. Smaller specimens may be used when deemed necessary. The test shall be carried out immediately after cutting the specimen.

**B-2 PROCEDURE**

**B-2.1** Weigh accurately each test specimen. This specimen shall then be dried in a ventilated oven at a temperature of  $105\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ . The weight shall be recorded at regular intervals. The drying shall be

considered to be complete when the variation between last two weighings does not exceed 0.002 g. The final weight shall be taken as oven dry weight.

**B-3 CALCULATION**

**B-3.1** The moisture content, expressed as percent of the dry mass, is given by the following formula:

Moisture content, percent of dry mass

$$= \frac{M_1 - M_0}{M_0} \times 100$$

where

$M_1$  = initial mass in g of the test specimen

$M_0$  = dry mass in g of the test specimen

## ANNEX C

### (Clause 6.4)

## DETERMINATION OF PULL STRENGTH

### C-1 APPARATUS

A simple instrument as shown in Fig. 5 can be used for testing the pull strength. This unit is suitable for mounting on wall. It consists of dial force gauge/weighing scale (0 kg to 10 kg) operating on spring (B) mounted on wooden plate (A). A tubular tuft-holder (C) is hung on the hook of dial gauge. A clamp for holding the brush (E) is provided which is movable downward and upward with a screw (G). The dial force gauge/weighing scale shall be calibrated having traceability to NPL.

NOTE — Manufacturer may use sophisticated electronic instrument available in market to determine the pull strength.

### C-2 PROCEDURE

**C-2.1** Fix a brush with bristles in upward direction in the brush holder with the help of screw (F).

Divide the bristles into 5 segments for oval/round brushes.

**C-2.2** Insert all bristles of one segment in the hole provided at the bottom of tubular tuft-holder (C). Care should be taken not to allow bristles from adjacent segment to enter in to the hole. Fix the bristles firmly with the help of screw (D).

**C-2.3** Adjust the pointer on dial to zero by adjustment of screw (G).

**C-2.4** Move down the brush holder slowly with screw (G) watching the pointer on dial carefully till it reaches 5 kg mark and keep it there for 1 min. Then remove the brush from the gadget and examine. The bristles of any segment shall not come out of the cement during the test.

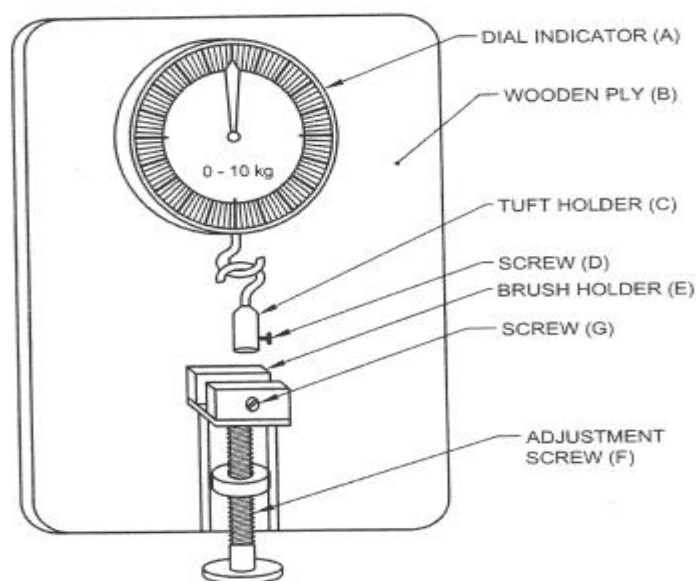


FIG. 5 INSTRUMENT FOR DETERMINATION OF PULL STRENGTH

**ANNEX D**  
(Clause 6.8)

**METHOD OF TEST FOR PROCESSING OF BRISTLES**

**D-1 GENERAL**

The object of this test is to determine whether the processing of the bristles, for elimination of their natural tendency to curve, has been adequate or not.

**D-2 TEST SAMPLE**

**D-2.1** A bunch of bristles, free from cement as prescribed under Annex D and consisting of at least 50 percent of the total mass of the filling material of the brush, shall constitute the test sample.

**D-3 PROCEDURE**

**D-3.1** Tie the test sample of the filling material with thread or linen tape at one end and suspend it in

water maintained at  $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  for 10 min. Remove the bristles from the water and shake to remove as much water as possible. Untie the knot and spread out all the bristles on a large sheet of blotting paper in a warm place. Allow to dry at room temperature for 48 h.

**D-3.2** The bristles shall then be examined and categorized as below:

- a) Bristles which are straight;
- b) Bristles which have a curvature of radius 230 mm or more (*see Fig. 5*); and
- c) Remainder.

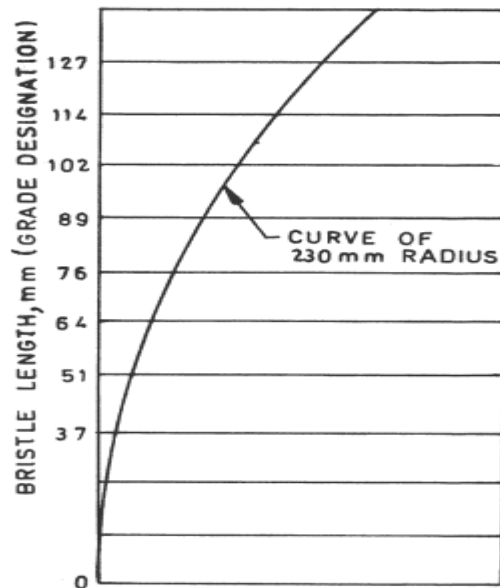


FIG. 6 CURVING OF BRISTLES

**ANNEX E**  
(Clause 6.10)

**METHOD FOR DETERMINATION OF MASS OF BRISTLES**

**E-1 GENERAL**

For determining the mass of bristles in a brush, they are detached by gentle hammering as described under **E-2.1**, or, if the bristles are set in vulcanized rubber, by soaking in a solvent and detaching the bristles from the cement as described under **E-2.2**.

**E-2 PROCEDURE**

**E-2.1 For Cement Other than Vulcanized Rubber**

Remove all connecting pins as well as those securing the handle. Cut the ferrule right through its length on any one of the sides by means of a chisel. Open the ferrule and remove the bristles. Hammer the root ends of the bristles gently with a raw hide mallet to reduce the cement to powder and shake the bristles. Repeat this process till all traces of cement are removed. Dry the bristles in an oven at

100 °C ± 2 °C for 30 min. Cool for 24 h in air and weigh under prevalent atmospheric conditions.

**E-2.2 For Vulcanized Rubber Setting**

Open the ferrule as described under **E-2.1** and remove the bristles. Soak the setting in an appropriate solvent until it is sufficiently friable to be broken down. This should normally take 12 h to 18 h. Remove the bristles from the solvent mixture and gently knead between the fingers so as to separate the bristles from the block into which they are mounted, but taking care that no undue force is used which may break the bristles. Repeat this process until the bristles are free from vulcanized rubber setting. Dry the bristles in an oven at 100 °C ± 2 °C for prevalent atmospheric conditions.

NOTE — Trichloroethylene is suitable for rubber and pitch settings, and acetone for synthetic resin settings.

## ANNEX F

### (Clause 6.6.3)

#### TEST METHOD FOR IDENTIFICATION OF RUBBER SAMPLE

##### F-1 ANALYSIS OF THE GIVEN RUBBER SAMPLE

**F-1.1** To check rubber set or not, for rubber set cementing the same will have elasticity properties of rubber. In case of vulcanized rubber set, the cementing would be rough and dark brown in uniformity that is, the same color would be observed inside the ferrule all over and not any shades of red or light brown since in case of vulcanization, the same would have been baked at a constant temperature. In case of vulcanized rubber set, the cementing will not be brittle and would be stretchable/elastic. IS 3400 with regard to vulcanized rubber may further be referred in case of any clarification.

##### F-1.2 Flame Test

Take about 0.02 g of sample in a clean, dry nickel spatula and introduce into bunsen flame. Remove the burning sample from the flame after 1 min.

Observation: The sample is found to burn continuously with a yellow sooty flame.

Inference: May be SBR (marigold smell of styrene was not observed) or NBR.

##### F-2 ELEMENTARY ANALYSIS

##### F-2.1 Sodium Fusion Extract Test

Take a small piece of pure sodium into an ignition tube and add a small quantity of sample to be tested and heat the tube gently until the ignition tube turn red hot. Plunge the tube into distilled water (10 ml) in a porcelain dish, cool and filter. The filtration is sodium fusion extract.

##### F-2.2 Nitrogen test

Boil 3 ml of the extract with 3 ml of freshly prepared 5 percent ferrous sulphate solution and cool. Add 10 ml of 5 N sulphuric acid and then two drops of 0.5 N aqueous ferric chloride.

Observation: A blue precipitate of ferric ferrocyanide is obtained.

Inference: Presence of nitrogen.

##### F-2.3 Sulphur test

Add a few drops of sodium nitroprusside to sodium fusion extract (SFE).

Observation: The appearance of a deep violet color.

Inference: Presence of sulfur.

##### F-3 DISINTEGRATION TEST

Boil a sample of about 0.05 g with concentrated  $\text{HNO}_3$  (2 ml) for a few minutes and note whether it disintegrates or not.

<i>Materials</i>	<i>Observation</i>	<i>Inference</i>
IIR, NR, NBR, EPDM, CR, SBR	It disintegrates	Belongs to group A
Polybutadiene rubber, Silicone rubber	It does not disintegrate	Belongs to group B

##### F-4 CONFIRMATORY TESTS

##### F-4.1 NBR

Take about 0.1 g of sample and heat in an ignition tube, and transfer the brown portion of the sample into 0.5 N of aqueous NaOH with 5 percent  $\text{FeSO}_4$  and add 0.5 N of sulphuric acid. Boil the solution for a few seconds and then add 0.5 N of aqueous ferric chloride.

Observation: Blue precipitate is obtained.

Inference: NBR is confirmed.

##### F-4.2 SBR

Reflux the given sample with concentrated  $\text{HNO}_3$  (10 ml) for half an hour, using a long air condenser. Then the mixture is poured into 25 ml of water, then extracted with 12.5 ml diethyl ether, the ethyl extract is washed with 1 N aqueous NaOH. The ethereal layer is extracted and acidified with 10 ml of concentrated HCl, 2.5 ml of granulated zinc, dissolved in 10 ml of HCl for 20 min. Then the mixture is cooled below 5 °C, added a freshly prepared aqueous solution of sodium nitrate (0.1 g of sodium nitrate in 5 ml of  $\text{H}_2\text{O}$ ). The resulting solution is poured into 0.05 g of  $\beta$ -naphthol in 10 ml of 5 N sodium hydroxide.

Observation: Vivid Scarlet Red colour is obtained.

Inference: SBR is confirmed.

##### F-5 FOURIER TRANSFORM INFRA-RED SPECTROSCOPY (FTIR)

FTIR involves the absorption of electromagnetic radiation in the infrared region of the spectrum,



which results in changes in the vibrational energy of the molecule. Since, usually, all molecules will be having vibrations in the form of stretching and bending, etc, the absorbed energy will be utilized in changing the energy levels associated with them. It is a valuable and formidable tool in identifying the compounds which have polar chemical bonds (such as OH, NH, and CH) with good charge separation (strong dipoles). It finds extensive use in the identification and structural analysis of the synthesized materials, natural products, polymers, rubbers etc. The presence of a particular functional group in a given organic compound can be identified. Since every functional group has unique vibrational energy, the IR spectra can be seen as their fingerprints. The infrared spectrum of the rubber mixed with KBr is recorded on ATR-Fourier

transform-infrared spectroscopy. The spectrum is collected in the range from 500  $\text{cm}^{-1}$  to 4 000  $\text{cm}^{-1}$  with a resolution of 3  $\text{cm}^{-1}$  by 100 scans, as shown in Fig 7.

Attenuated total reflection (ATR) is a simple technique to take and confirm the sampling, and samples are examined directly in solid, film, powder and liquid state without preparation of KBr pellet. The polymers or rubber are characterized through FTIR and ATR method (Fig. 8), film polymer is analyzed by ATR method, faster sampling, improving spectrum to better quality database building for the more precise material verification and identification. ATR is clearly an extremely robust and reliable technique.

#### F-5.1 Fourier Transform Infra-Red Spectroscopy (FTIR) by KBr (Potassium Bromide) method

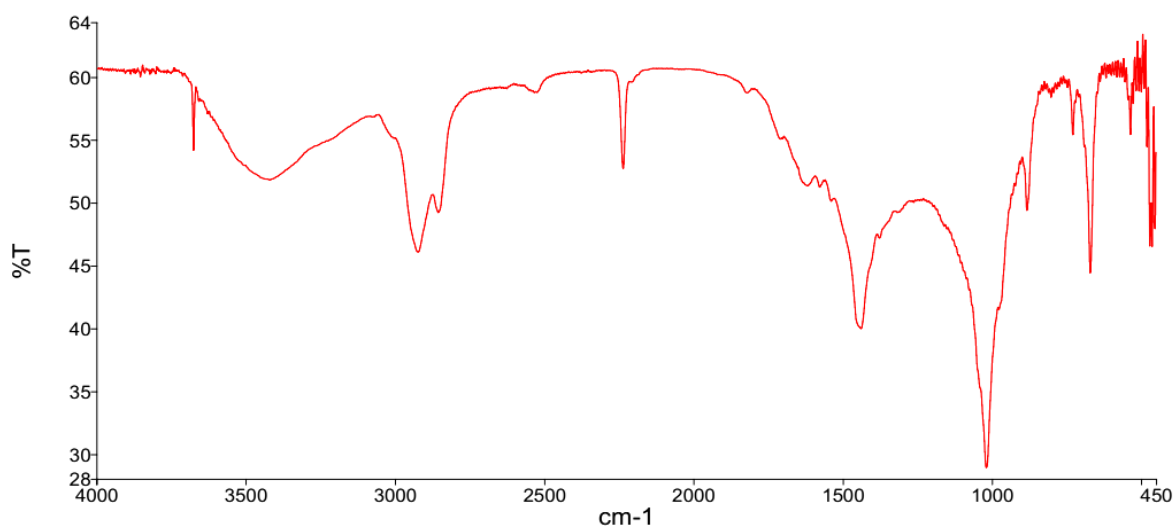


FIG. 7 FTIR OF CROSSLINKED RUBBER

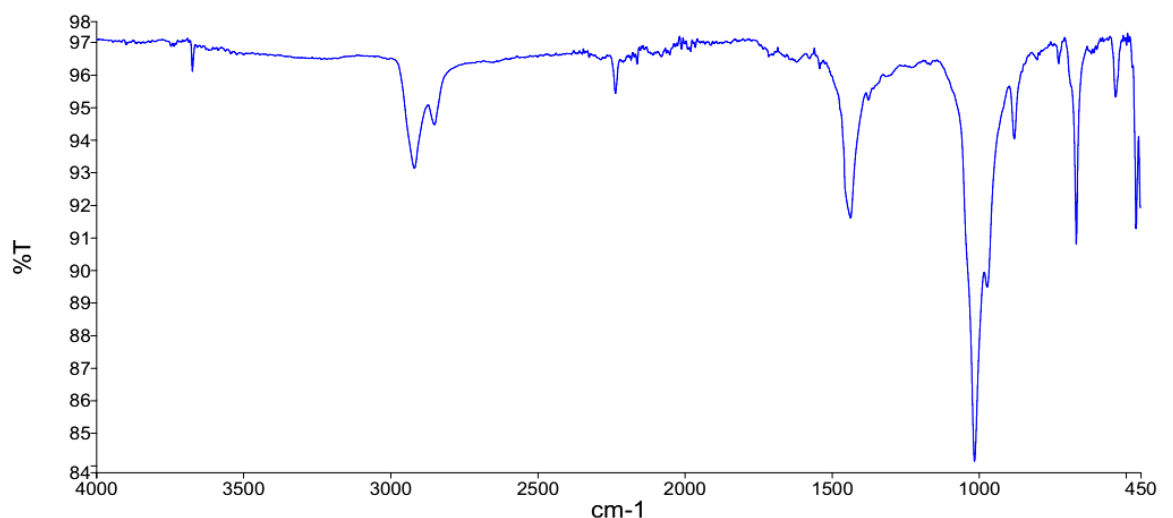
**F-5.2 Attenuated Total Reflection (ATR) – FTIR**

FIG. 8 ATR-FTIR OF CROSSLINKED RUBBER

**Observation from FTIR**

From Fig. 7 and Fig. 8, there is a sharp peak observed at 2 237 cm<sup>-1</sup> is responsible for the alkyl group present in the rubber. Based on this, it is confirmed that the rubber is NBR rubber.

**F-6 DIFFERENTIAL SCANNING CALORIMETRY (DSC)**

This technique is more or less similar to DTA except that it measures the amount of heat absorbed or released by a sample as it is heated or cooled or kept at a constant temperature (isothermal). Here the sample and reference material are simultaneously heated or cooled at a steady rate. The difference in temperature between them is proportional to the difference in heat flow (from the heating source that is, furnace), between the two materials. This

technique is applied to most of the polymers in evaluating the curing process of the thermoset materials as well as in determining the heat of melting and melting point of thermoplastic polymers and rubbers, glass transition temperature ( $T_g$ ), endothermic and exothermic behaviour and crystallization temperature. Through the adjunct process of isothermal crystallization, it provides information regarding the molecular weight and structural differences between very similar materials. The instrumentation is precisely identical to that of DTA except for the difference in obtaining the results. The thermal transition temperatures were determined by differential scanning calorimetric (DSC) analyses using NETZSCH DSC 214, at 5 °C and 10 °C per min under an inert nitrogen ( $N_2$ ) atmosphere from 0 °C to 250 °C, given in Fig. 9 and Fig. 10.

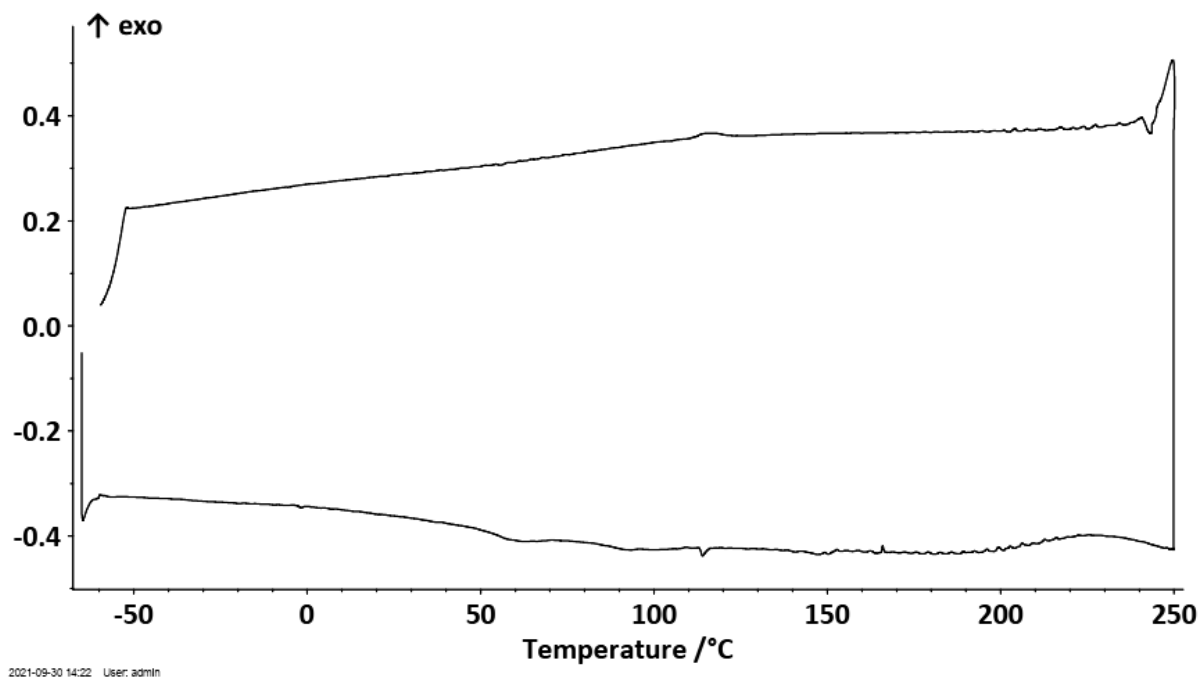


FIG. 9 DSC OF CROSSLINKED RUBBER (HEATING RATE: 10 °C/MIN, IN NITROGEN ATMOSPHERE)

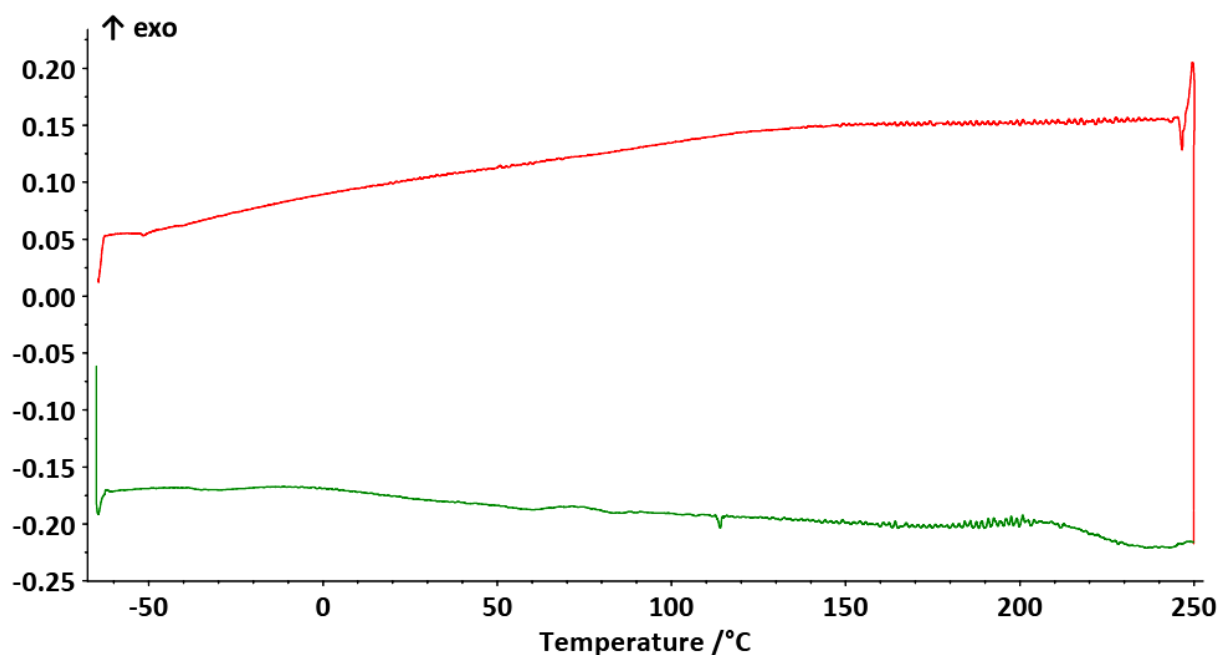


FIG. 10 DSC OF CROSSLINKED RUBBER (HEATING RATE: 5 °C/MIN, IN NITROGEN ATMOSPHERE)

Observation: The glass transition temperature ( $T_g$ ) of the NBR (see Fig. 10) is -36.5. The literature value for the NBR  $T_g$  is -38.0 °C.

#### F-7 CONCLUSION

- i) The rubber is NBR based on the FTIR and DSC results.
- ii) The rubber Nitrile rubber (NBR) is possible to crosslinked with peroxide/sulphur. In the

elemental analysis, a partial sulphur content was determined.

- iii) Methods at **F-1**, **F-2** and **F-3** shall be for routine testing and Methods **F-4**, **F-5** and **F-6** shall be referee methods in case of any dispute. In case any sample is failing under any of the methods **F-1**, **F-2** or **F-3**, the same will be treated as rejected.

**ANNEX G**  
(Clause 9.2)

**SAMPLING AND CRITERIA FOR CONFORMITY**

**G-1 SCALE OF SAMPLING**

**G-1.1 Lot**

In any consignment, all the brushes of the same type and size shall be divided into groups of 1 000 brushes and each such group shall constitute a lot. Care shall be taken to ensure that brushes included in a lot do not differ in construction, as far as possible.

**G-1.2** The conformity of the brushes in a lot to the requirements of this standard shall be ascertained for each lot separately.

**G-1.3** The number of brushes to be selected for this purpose shall be in accordance with Table 4.

**G-1.3.1** The brushes shall be selected at random. To ensure randomness of selection, a random number table as agreed to between the purchaser and the supplier shall be used. In case such a table is not available, the following procedure shall be used:

- a) If all the brushes in a lot are packed in one box, then starting from any brush, count them in any suitable order as 1,2 ..., up to  $r$  and so on, where  $r$  is the integral part of  $N/n$  ( $N$  and  $n$  being the lot size and sample size

respectively). Every  $r^{\text{th}}$  brush thus counted shall be withdrawn to constitute the sample; or

- b) If the brushes in a lot are packed in more than one box, approximately equal number of brushes shall be picked up at random from as many boxes as possible so as to obtain the required number of brushes as specified in Table 4.

**G-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY**

**G-2.1** All the brushes selected according to **G-1.3** shall be examined for constructional requirements given under **6.2** to **6.3**. A brush failing in one or more of these requirements shall be considered as defective.

**G-2.2** The lot having been found satisfactory according to **G-2.1** shall further be subjected to tests given under **6.4** to **6.10**. For this purpose, three brushes shall be selected from a lot containing 500 or less brushes and six from a lot containing more than 500 brushes, whatever may be the lot quantity or offered quantity for inspection. These brushes may, however, be taken from those already examined and found satisfactory according to **G-2.1**.

**Table 4 Scale of Sampling**  
[Clauses G-1.3 and G-1.3.1 (b)]

SI No.	No. of Brushes in the Lot	No. of Brushes to be Selected
	N	n
(1)	(2)	(3)
i)	Up to 10	2
ii)	11 to 25	3
iii)	26 to 50	4
iv)	51 to 100	5
v)	101 to 150	6
vi)	151 to 300	7
vii)	301 to 500	8
viii)	501 to 750	9
ix)	751 to 1 000	10

**G-2.2.1** Pull test, benzene alcohol test and oven test shall be performed first, on each of the brushes selected according to **G-2.2** and then these brushes shall be subjected to mass of bristles per finished brush, curving of bristles and detection of dyed bristles in this order, according to methods given in **6.7**, **6.8** and **6.10** respectively.

**G-2.2.2** The lot shall be deemed to have met the requirements for these tests if no failure occurs under **G-2.2**, otherwise not.

### **G-3 CRITERIA FOR CONFORMITY**

The lot shall be declared as conforming to the requirements of this specification if **G-2.1** and **G-2.2** are satisfied.

NOTE — For description of bristles (*see* **6.1.1**) and workmanship and finish (*see* **6.11**), the brushes selected according to **G-1.3.1** shall be matched with the approved tender sample which is suitably stamped and sealed by the purchaser or the inspection authority and kept at a place agreed to between the two.

**ANNEX H**  
(Foreword)

**COMMITTEE COMPOSITION**

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